RDM Lifetime measurement in ^{100}Ru

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Introduction

The energy level sequences of nuclei in A ~ 100 mass region show an interesting interplay between single-particle and collective degrees of freedom. The *E*2 transitions in nuclei $^{96\text{-}98}$Ru and ^{97,98}Rh [1-4] provide the first indication of onset of collectivity for neutron numbers as low as N=52 in this mass region. Conventionally, collectivity in nuclei has been examined by observing the experimental $R_{4/2}$ ratio (i.e. $E_{4_1^+}/E_{2_1^+}$) but its confirmation needs B(E2) values. In A ~100 mass region, on looking at the trend of $R_{4/2}$ ratio with neutron number for even-even Ru isotopes (Plotted in Figure 1), it can be inferred that nuclei with $N \leq 56$ show vibrational character with $R_{4/2} \leq 2.27$, while the nuclei above N > 58 show rotational behavior with $R_{4/2} > 2.3$. A more clear understanding of the nature of collectivity requires experimental B(E2) for these Ru nuclei. With this motivation, B. Kharraja et al., [5] performed the Recoil-distance lifetime measurements for low and moderate spin transitions in ^{96,97,98}Ru and H.G. Borner performed the GRID lifetime measurements for low spin states in ^{102}Ru [6]. The measured transition probabilities in ^{98}Ru suggest that the nucleus has both single-particle and vibrational character. To see how the nature of this nucleus changes with addition of 2 neutrons, we performed RDM lifetime measurement in yrast sequence of ^{100}Ru at Inter University Accelerator Center (IUAC), New Delhi.

Experimental details and data analysis

In the experiment ^{94}Zr (^{12}C, α2n) ^{100}Ru reaction, at a beam energy of 57 MeV was used. Compton suppressed singles data were recorded at 23 target-to-stopper distances ranging from 10 μm to 6.3 mm. The emitted γ-rays were detected with Gamma Detector Array (GDA) setup at IUAC. The experiment was done with five Compton suppressed HPGe detectors, arranged in two different rings of GDA, making angles 144^0 (3 –detectors) and 50^0 (2-detectors) with the direction of the beam. The quality of the data obtained in the experiment is shown in Figure 2. The data analysis was done with the computer code, LIFETIME [7]. The (preliminary) results of the analysis are very encouraging and indicate a different scenario for ^{100}Ru nucleus. In combination with B(E2) values

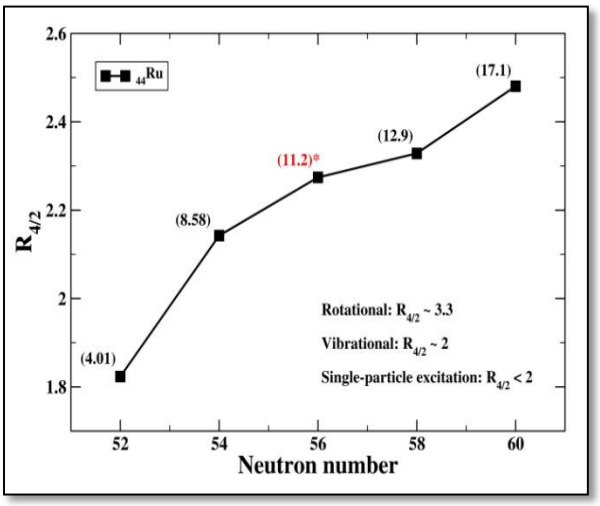

Fig. 1: The plot of $R_{4/2} = E(4_1^+)/E(2_1^+)$ values for the Ru nuclei with Neutron number. The number shown in the bracket are measured B(E2: 2^+ - 0^+) values. (* marked: Value from present work).

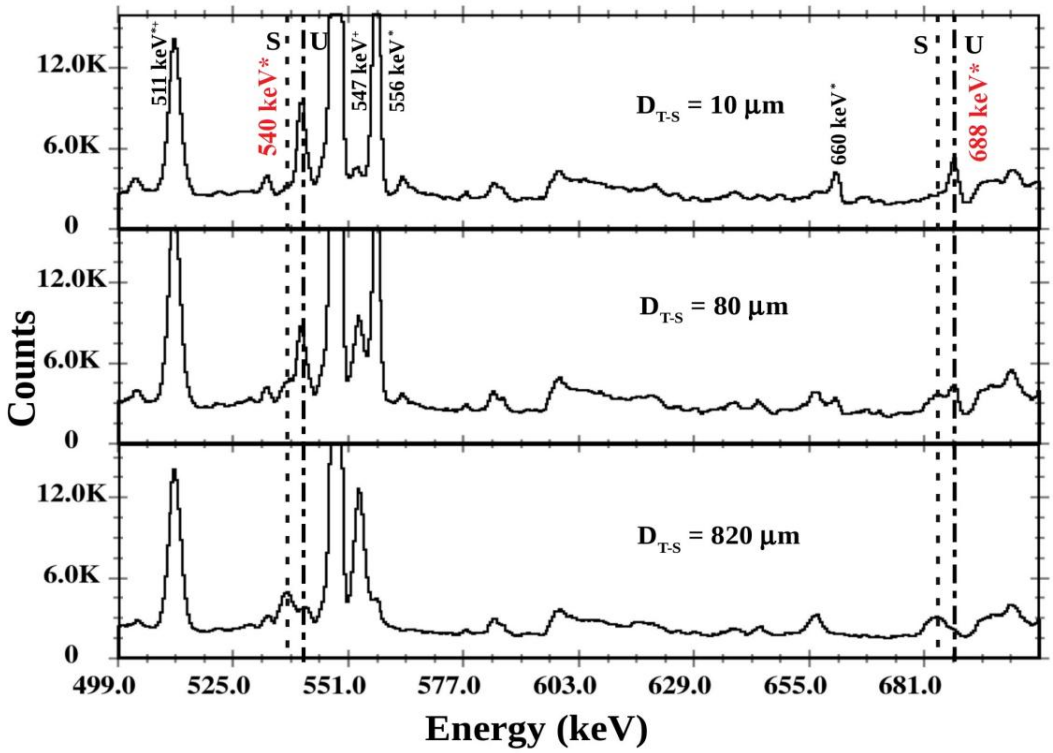

Fig. 2: The calibrated data showing the shifted (S) and unshifted (U) peaks of 540 keV and 688 keV γ-ray transitions of yrast band of ^{100}Ru nucleus for three different target-stopper distances (D_{T-S}), taken with three HPGe detectors at 144^0 (backward angle) with respect to beam direction. (* marked: γ-ray peaks from nuclear reactions, $^{*+}$ marked: e^+ - e^- annihilation peak, $^+$ marked: Coulex of ^{197}Au.)

obtained for ^{96,98,102}Ru in the previous measurements, the present B(E2) value when plotted as a function of neutron number, clearly shows the changing nature of excitations from vibrational to rotational for Ru nuclei with increasing neutron number.

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